SOME PROBLEMS ABOUT TAKINOSAKA LANDSLIDE

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BY

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1. Observation

At Takinosaka tōge, Kanagawa Prefecture, after the road was cut off, landslide came to meet people's eyes.

The clay which exposed to the road-side cliff is apt to suck water and liquefy. And it flows to the road over the wall after rainfall reached some quantity. Therefore piling method was appointed in this region.

The position of piles line, tiltmeter and strain-gauged-pipe are shown in Fig. 1.

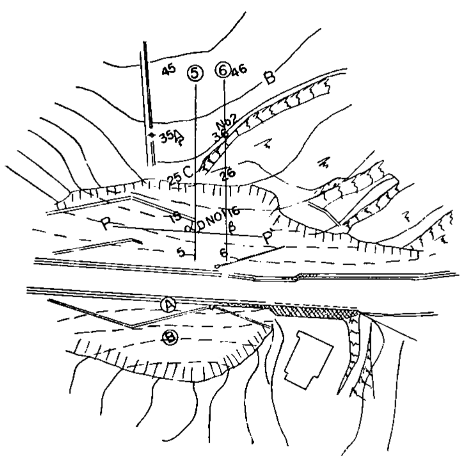

Fig. 1 Location of observation.

No. 1, No. 2	:	Strain gauged pipe
A, B, C	:	Tilt meter
P–P'	:	Line of piles
D		Earth pressure gauge
⑤, ⑥	:	Measured line of electric survey
5, 15, 25, 35, 45, 6, 16, 26, 36, 46	:	Measured point of electric survey

The process of deformation of strain-gauged-pipe at No. 2 is shown in Fig. 2 and it shows that the stratum between 11–23 meters in depth is slide stratum.

The quantity of every fine days of the deformation is shown in Fig. 3 and it shows that the deformation advances or recovers according whether it rains or not, respectively.

From the observed values of tiltmeters in A, B and C spots, we can calculate the monthly tilt amount and monthly accumulated value of absolute daily tilt amount.

These figures are shown in table-1.

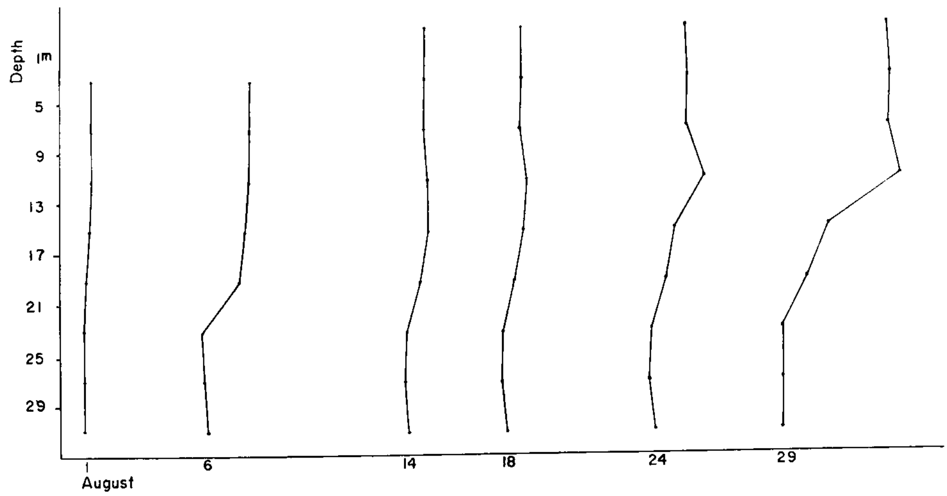

Fig. 2 Accumulated strain of plastic pipe which is inserted into boring hole. Deformation is enlarged to 1500.

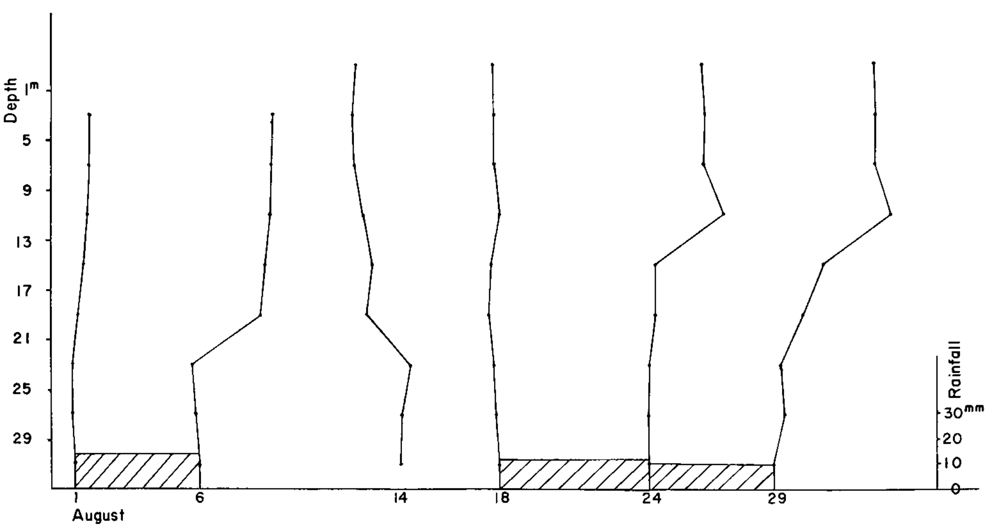

Fig. 3 Strain of plastic pipe per 5 days which is inserted into boring hole. Deformation is enlarged to 2000.

Table 1 Records of Tiltmeter

		A				B				C			
		NS		WE		NS		WE		NS		WE	
		T.*	M.**	T.*	M.**	T.*	M.**	T.*	M.**	T.*	M.**	T.*	M.**
1960	Oct.												
	Nov.	- 27	95	- 25	123	7	77	- 6	92				
	Dec.	- 97	166	- 32	121	- 4	144	9	133				
1961	Jan.												
	Feb.												
	Mar.												
	Apr.	- 38	214	- 53	148	18	199	-13	90				
	May.	- 61	147	-153	131	15	49	15	53				
	June.	-158	198	- 81	113	21	47	6	32				
	July.	- 45	91	- 94	102	- 8	41	6	35	-670	679	-128	678
	Aug.	- 71	103	-106	176	29	65	-57	75	-963	1270	79	579
	Sep.												
	Oct.												
	Nov.												
	Dec.												
1962	Jan.	- 21	78	- 9	73	- 3	23	- 8	34	-285	457	-100	374
	Feb.	- 33	69	10	56	- 7	25	-11	37	31	455	-176	264
	Mar.	- 24	66	- 3	59	- 7	45	5	63	- 14	435	96	358
	Apr.	- 42	58	- 18	42	- 6	60	- 3	44	- 2	1264	-199	501
	May	-127	147	- 37	97	15	67	- 9	33	43	619	-153	469
	June	- 85	114	- 85	113	-13	37	16	36	- 3	413	182	498
Monthly Mean before Piling		-61.2	129.0	-60.3	116	7.5	74.4	-6.55	64.5	-471.8	715.2	-81.5	473.8
Monthly Mean after Piling		-69.5	96.0	-35.6	77.8	-2.7	50.2	2.2	44.0	6.0	682.7	-18.5	456.5

* Tilt Amount for Month

** Month Accumulation absolute Tilt for Day

Calculating from this table, we can recognize that all the average values of tilt amount after piling are smaller than the average values before piling.

All the day when the rainfall is over 20 mm were checked, and common and absolute tilt amount of every seven days after that rainy day was totalized and are shown in Fig. 4 and Fig. 5.

We are able to know the influence of the rainfall on the earth foundation of these spots.

In considering that the record of A usually have a tendency of south down.

We are able to admit that A spot becomes north down and B spot becomes south down.

From the graph about absolute tilt amount, shown in Fig. 5, we can see that the inclination of earth foundation caused by rain is large on that day and is small on the other day.

But the influence of rain does not be addmitted from the same graph showing

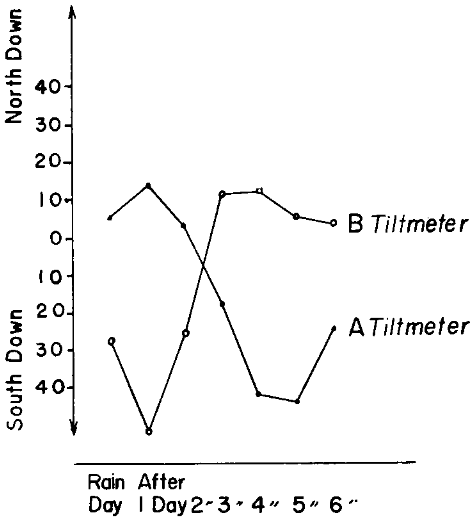

Fig. 4 Effect of rainfall on earth foundation before piling.

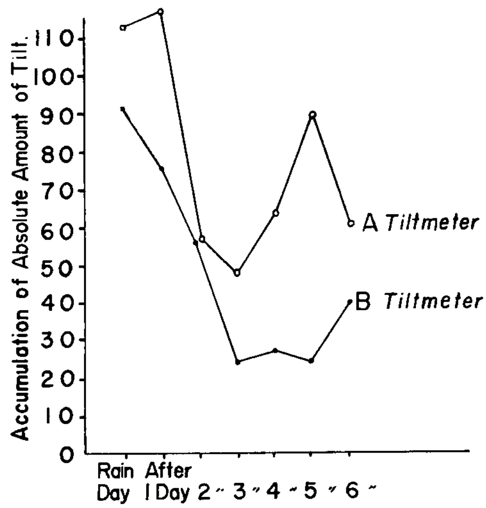

Fig. 5 Effect of rainfall on earth foundation before piling.

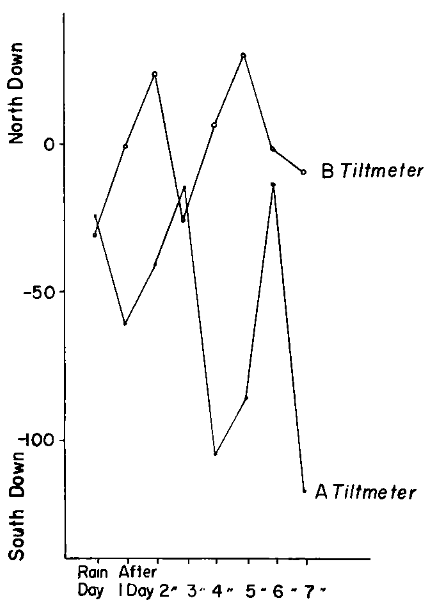

Fig. 6 Effect of rainfall on earth foundation after piling.

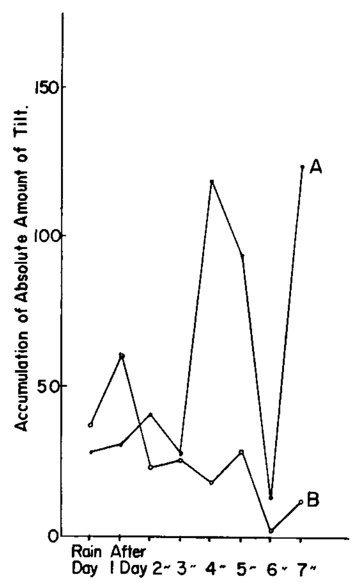

Fig. 7 Effect of rainfall on earth foundation after piling.

the influence of rain, after piling, on earth foundation, shown in Fig. 6 and Fig. 7. This mean the piling is effective.

2. On Electric Survey

In this region, electric survey was done by L-10 apparatus.

Analysis was done by standard curve method.

From estimated profile of 5 and 6 lines the thickness of clay stratum at α and β is considered to be 4-8 meters, shown in Fig. 8, 9.

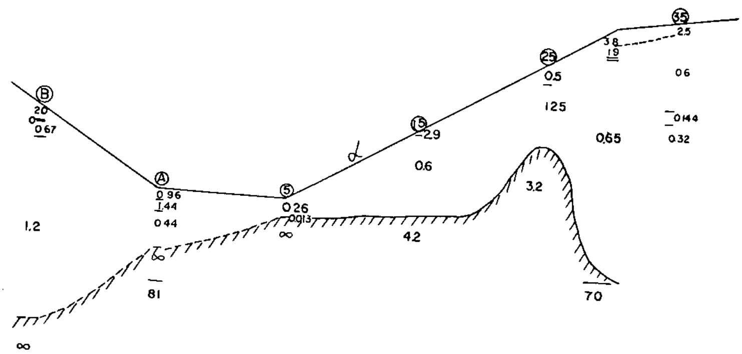

Fig. 8 Earth foundation profile of 5 line. Scale ; 1 . 480 Figures in the dragram indicate electric resistance.

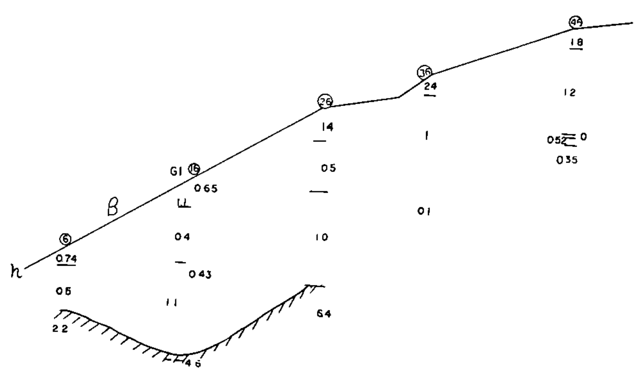

Fig. 9 Earth foundation profile of 6 line. Scale ; 1 : 610 Figures in the diagram indicates electric resistance.

But from the result of boring, the boundary of clay stratum does not exist in such depth.

Therefore strain-gauged-pipe and earth-pressure-gauge have been buried in No. 1 spot.

Observed values are shown in Fig. 10 and Fig. 11.

From Fig. 10, we can admit that the movement exists in upper part above 6 meters in depth and slide does not exist below the depth.

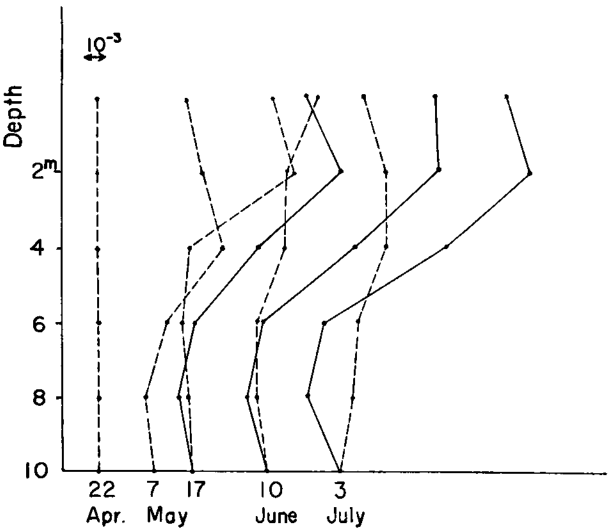

Fig. 10 Strain of pipe which is inserted into boring hole. Real lines indicate accumulated strain. Dotted lines indicate strain variation between measured days.

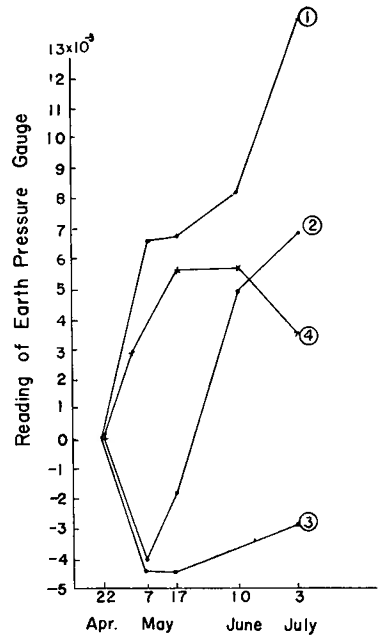

Fig. 11 Observation by earth pressure gauge.
1 : depth 1.3 m
2 : depth 2.1 m
3 : depth 2.9 m
4 : depth 4.5 m

The earth pressure is high near the ground surface, shown in Fig. 11, and this coincides with the result of movement style estimated from Fig. 10.

3. On Burning Method

The clay samples which are formed, 7 cm in length and 3 cm in diameter are fired in electric furnace.

The tests were done in various burning hours and temperatures.

And the burned samples were rested in the air until they became constant weight.

The difference between the weight instantly after burning and the constant weight was calculated.

The ratio between the difference and the weight instant after burning was taken as axis of abscisses, and burning time as axis of ordinates.

The graphs were made in various burning temperature.

One example is shown in Fig. 12.

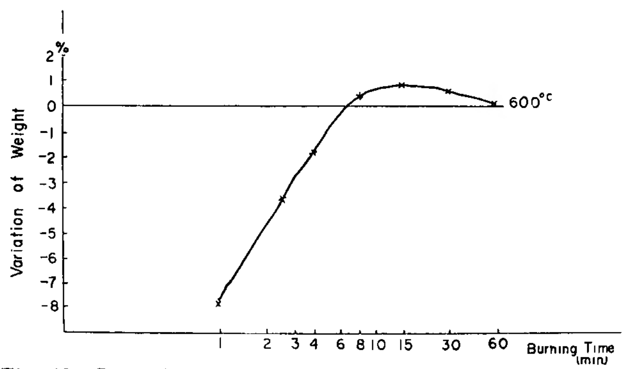

Fig. 12 Curve between variation of weight and burning time burning temperature is 600°C.

If the hour of burning is small, the moisture left in burned sample evaporate into the air, so the ratio is negative.

As the hours of burning increases, amount of evaporate water decrease.

Accordingly, the negative amount of the ratio decrease.

The hours of burning still more increases, the burned samples absorb vapour from the air and increase their weights, so the ratio becomes positive.

But the hour of burning further increases, the ratio decreases and finally becomes zero because the ratio has maximum value.

That the weight of sample has nothing to do with vapour pressure in the air, means the sample doesn't receive the influence of suction force thermodynamically or the sample doesn't change its weight and strength even in the water.

The relation between burning temperature and hours which represent this

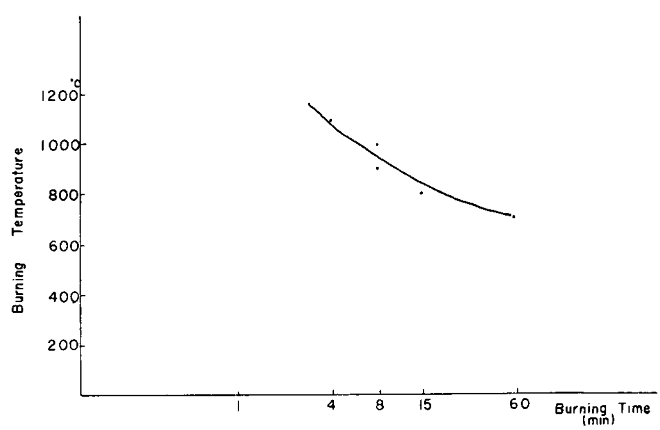

Fig. 13 Relation between burning time and temperature, in this state the burned clay does not change its weight in the atmosphere.

state is shown in Fig. 13.

Practically we examined the strength of sample in the water after burning.

We kept the burning time as 20 minutes and change burning temperatures as 900°C, 800°C, 700°C and 600°C.

How the strengths of samples burned invarious temperature decrease against with the increase of dipped hour are shown in Fig. 13.

In this figure, the strength ratio of the burned sample for the one bef(re burning is expressed as axis of abscisses and the hour dipped in water is expressed as axis of ordinates.

From Fig. 13, strength ratio is constant for the immersed hour in case the burning temperature are over 800°C, but it decrease as the immersed hour increases in case below 700°C.

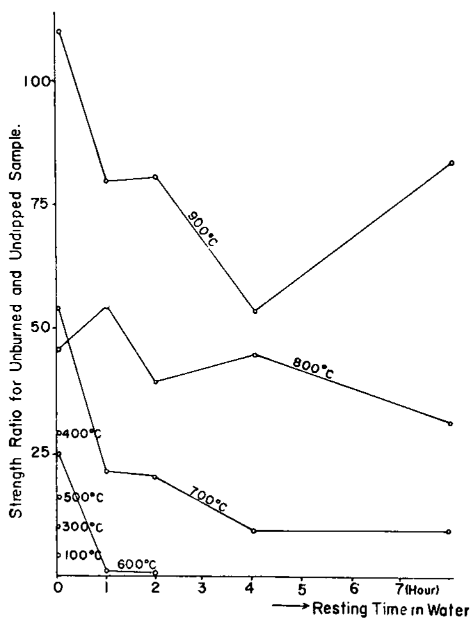

Fig. 14 Relation between strength variation and resting time in water of burned clay. Figures in the diagram indicate burning temperature.